

# ANNUAL REPORT 2008

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#### ON THE RIGHT ROAD WITH NIP AND NOW

What do energy and transport have in common? Not too long ago, the answer would have been relatively simple. The »lead currency« of mobility was mineral oil, and very few people were talking about an energy shortage, climate change or globalization. The energy risk of the 21st century is forcing us to rethink. For a long time, fossil fuels were a modern and convenient energy resource. But they are finite, are therefore becoming more expensive and are damaging the climate.

NIP, the National Innovation Programme for Hydrogen and Fuel Cell Technology, initiated as a strategic alliance between politics, the scientific community and industry and approved by the German federal government in 2006, covers the core of our policy for the future. To ensure Germany's sustainability as an industrial location and to keep mobility affordable for the population, we must prepare the market today for the clean technologies and alternative fuels of the future. Hydrogen and fuel cell technology is clean and efficient. It has the potential to play a decisive role in the near future: both in the generation of power and hot water for our homes and for future individual mobility. The potential of hydrogen and fuel cells becomes apparent from the NIP lighthouse projects: technological applications are already proving themselves in everyday use in the Clean Energy Partnership (CEP) in the transport section and in the Callux lighthouse for domestic energy supply.

»The whole is greater than the sum of its parts«, this popular definition of the concept of »synergy« also describes NOW's comprehensive mission. Created as a federally-owned company for the implementation and management of NIP, its job is to combine the host of differing individual project applications from the scientific

» Hydrogen and fuel cell technology is clean and efficient. It has the potential to play a decisive role in the near future.«

community and industry into exhaustive field tests and integrated projects. Only in this way can we create the optimal conditions which will turn test applications into everyday products within the course of a few years.

The CEP – the mobile hydrogen lighthouse project – is such a partnership, as it takes this young technology further than any of the individual partners can currently go. Since its foundation in 2003 CEP has been successfully operating one of the biggest hydrogen demonstration projects in the world – and NOW is now promoting ongoing expansion, with new partners, additional hydrogen vehicles and fuelling stations and new regional partners, such as Hamburg.

Over the next few years, the Callux lighthouse will provide 800 homes with fuel cell heating devices. Here, too, NOW has brought together a number of different players. Competing enterprises from several sectors of industry are now working together for the future of heat and energy supplies to our homes. And I'm sure we'll be hearing more about further lighthouse projects, BODENSEE and NEEDS, for example, in 2009.

Efficient coordination of the programme's various partners and tasks will promote the accelerated technological development and market launch of hydrogen and fuel cell technology. With the right programme, a committed hydrogen and fuel cell sector and a splendid team at NOW, I feel that we are really moving in the right direction.



Wolfgang Tiefensee  
Federal Minister of Transport, Building and Urban Affairs

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#### LADIES AND GENTLEMEN,

NIP, the National Innovation Programme for Hydrogen and Fuel Cell Technology, was initiated as a strategic alliance between politics, the scientific community and industry in order to accelerate market preparation for these technologies. This is beneficial to both our industry and the climate. NOW GmbH, National Organization Hydrogen and Fuel Cell Technology, was founded on Feb. 18, 2008 to manage and implement NIP.

NOW's mission includes the design and evaluation of demonstration projects, the coordination of demonstration projects with research and development projects and cross-sectional topics such as hydrogen safety or questions of approval, communication and the design of international cooperative ventures. After almost a year, a time dedicated to initiating the implementation of NIP and building up the NOW organization, the first annual report of NOW GmbH provides an overview of what has been achieved.

By the end of 2008 industry, together with the relevant scientific institutions, had submitted to NOW no less than 85 project outlines for demonstration projects to be subsidized by the Federal Ministry of Transport, Building and Urban Affairs (BMVBS) with a total volume of € 540 million. Funding from the NIP budget for this sector amounts to some € 250 million. In addition to this, focussed research and development projects funded by the Federal Ministry of Economics and Technology (BMWi) are being continued as part of the government's energy research programme.

» NOW has created a platform for cooperation at a stage before competition arises and is thus helping to accelerate the market entry of hydrogen and fuel cell products. «

Implementation of the demonstration projects is usually carried out within »lighthouse projects«, which make extensive use of common factors and synergies between individual projects. The lighthouse projects Clean Energy Partnership (CEP) in the transport sector and Callux in the field of domestic energy supply are fully operational. Additional lighthouses, such as NEEDS for industrial energy supply and BODENSEE in the field of leisure and tourism, and a lighthouse on critical power supply, in digital radio networks for public authorities, for example, have been initiated.

Project Management Jülich supports NOW in the handling of these subsidized projects. I should like to mention here that the path leading to the foundation of NOW GmbH was a long one, and one which would not have been possible without continued support from those responsible in politics, the scientific community and industry.

NOW has created a platform for cooperation at a stage before competition arises and is thus helping to accelerate the market entry of hydrogen and fuel cell products – a model which could prove to be a pioneering example for other technologies in the areas of energy and transport.



Dr. Klaus Bonhoff,  
Managing Director (Chair)



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#### NIP'S FUNDING COMES FROM

**BMWi:** € 200 million  
**BMVBS:** € 500 million  
**Industry:** € 700 million



#### NIP – THE STRATEGIC ALLIANCE BETWEEN FEDERAL GOVERNMENT, THE SCIENTIFIC COMMUNITY AND INDUSTRY

To guarantee a clean energy supply and to maintain Germany's global competitive position in the future – these are the aims set by the federal government, the scientific community and industry with the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP). Hydrogen and fuel cell technology offers great potential in the fields of mobility, energy efficiency and an environment-friendly energy supply. However, applications and products based on this technology are not yet widely represented on the market.

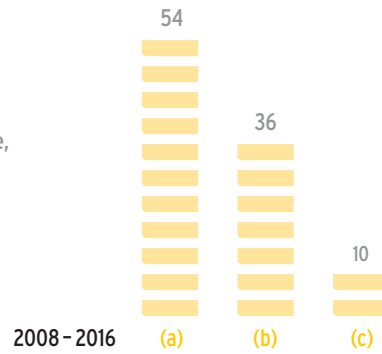
The strategic alliance between the German government, the scientific community and industry has therefore initiated the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP). The aim of NIP is to make a decisive contribution to accelerating market preparation for hydrogen and fuel cell applications in Germany so that products rapidly become ready for the market and for series production. This is why its emphasis is on subsidizing large-scale projects aimed at demonstrating the everyday use of these products as well as research and development work at a basic level.

Designed to run for a period of 10 years, up to 2016, NIP has a total budget of € 1.4 billion provided in equal parts by the German government – the Federal Ministry of Economics and Technology (BMWi) and the Federal Ministry of Transport, Building and Urban Affairs (BMVBS) – and the industries involved. NIP has specified three areas of market preparation for hydrogen and fuel cell technology. These are »Transport including hydrogen infrastructure«, »Stationary applications« and »Special markets«.

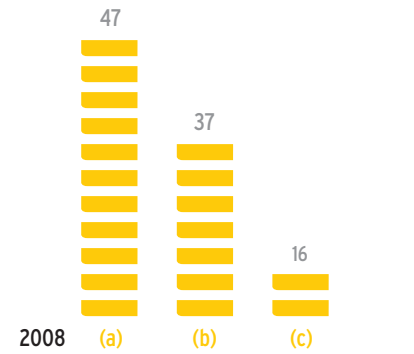
**NIP FUNDING BROKEN DOWN BY APPLICATION  
(AS PERCENTAGES)**

The overall budget is divided between

- (a) Transport including hydrogen infrastructure,
- (b) Stationary applications and
- (c) Special markets.



Basis: National development plan for NIP



Budget breakdown of project outlines received in 2008

» The aim of NIP is to make a decisive contribution to the acceleration of market preparation for hydrogen and fuel cell applications in Germany so that products rapidly become ready for the market and for series production.«

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## NOW – GETTING THINGS GOING

The federal government, represented by the Ministry for Transport, Building and Urban Affairs (BMVBS), in February 2008 set up a federally-owned company to coordinate and manage NIP: the National Organization Hydrogen and Fuel Cell Technology, called NOW for short. Since that time, NOW has acted as interface for the strategic alliance of government, the scientific community and industry.

As well as shaping and coordinating NIP, NOW's mission includes the evaluation of the demonstration projects submitted, linking the demonstration projects with research and development work, cross-sectional tasks such as studies, communicating NIP's aims and cultivating international relations in the field of hydrogen and fuel cell technology.

NOW is more than a classic manager of subsidies here. It repeatedly brings together developers, researchers and political personalities in its committees and provides space for NIP to develop flexibly and in line with its requirements. Formulating political aims, promoting new technologies, preparing markets – this is an integral process in which the partners involved are continually providing each other with new stimulus and valuable feedback. In this way optimum use can be made of the specific strengths of each individual partner.

In addition to research and development work NOW also concentrates particularly on projects in which hydrogen and fuel cell products are used in everyday life. This emphasizes the fact that hydrogen and fuel cell technology already represents a forward-looking alternative to fossil fuels and high-emission drives.

## THE LIGHTHOUSE PRINCIPLE

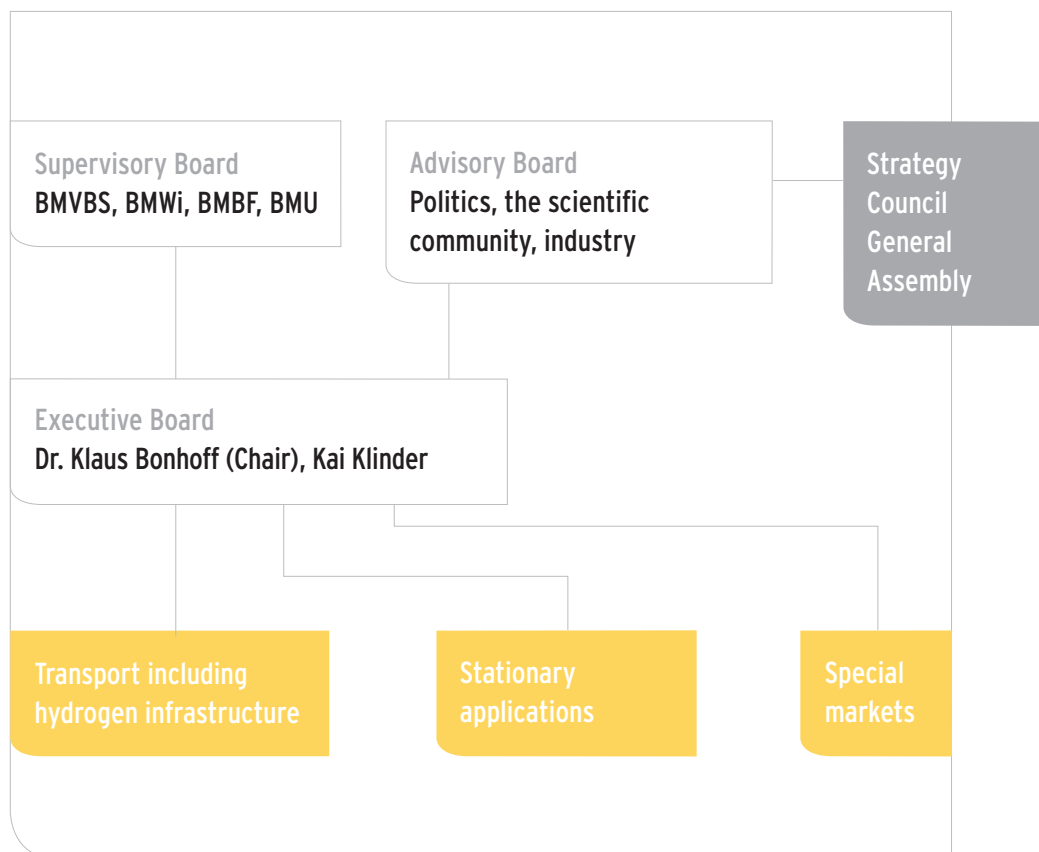
NOW bundles individual projects by topic or region in a meaningful way to create project clusters for which demonstration tests can be carried out more comprehensively and in more practical circumstances. This also gives the projects a higher profile, of course, and allows the partners to learn together. Collective projects of this kind are called »lighthouses«.

Demonstration projects of this kind account for the majority of NIP's activities. 65 percent of NIP's budget is allocated to demonstrating the reliability and practicality in everyday use of components and systems and is thus systematic preparation for later commercial use.

In its very first year of operation, NOW has succeeded in kicking off a number of promising lighthouses which it now supports. These include the Clean Energy Partnership (CEP), Callux, NEEDS, and BODENSEE, all projects of which we are certain to hear and read much more in the next few years.

## STRUCTURE OF NOW

**Partners:** Federal Republic of Germany (100 %) represented by the Federal Ministry of Transport, Building and Urban Affairs (BMVBS)



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## MOBILE WITHOUT POLLUTANTS – PROGRAMME SECTOR TRANSPORT INCLUDING HYDROGEN INFRASTRUCTURE





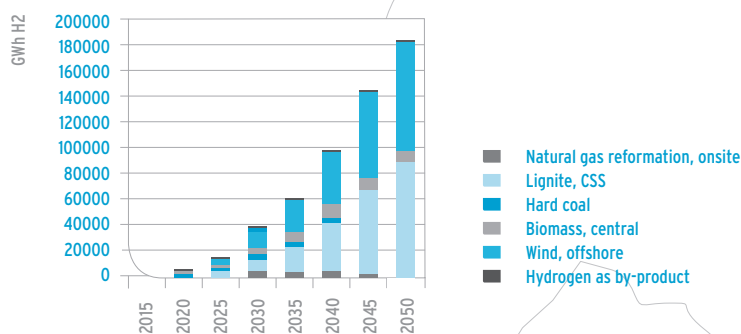


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Only a few years from now we will be forced into the large-scale replacement of fossil fuels by renewable ones and of high-emission drive technologies by environment-compatible ones. There will be no alternative if we are to maintain a high level of individual mobility in the future.

At the same time, Germany is concerned to maintain its position as one of the world's top commercial and industrial nations. To achieve these two aims – climate protection and a profitable industrial sector – industry, politics and the scientific community must work together to produce new, forward-looking solutions. NOW sees itself as a platform and a partner. NOW was born of the conviction that hydrogen and fuel cell technologies increase the climate compatibility of modern mobility requirements while also providing economically sustainable solutions for Germany as an industrial nation.

A good 50 percent of the overall budget of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP) has been allocated to the NOW programme sector Transport including hydrogen infrastructure. As well as the promotion of research and development, this sector focuses especially on demonstration projects aimed at proving that, even today, hydrogen-powered cars and busses can be developed as an alternative in normal road traffic. The aim of the programme sector Transport including hydrogen infrastructure is to thoroughly test hydrogen and fuel cell technology in everyday use. This is why it includes not only vehicles, but also the necessary hydrogen infrastructure (such as hydrogen fuelling stations), hydrogen production and related sectors such as onboard power supply for aircraft using fuel cells.



Scenario for hydrogen production from the GermanHy-Study (Moderate scenario)



**» We are convinced that hydrogen and fuel cell technologies will both increase the climate compatibility of modern mobility requirements and provide economically sustainable solutions for Germany as an industrial nation.«**



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Its special properties make hydrogen the ideal storage medium for a wide range of primary energies.



## KEY FIGURES, CEP

**Partners:** General Motors / Opel, BMW, BVG, Daimler, Ford, Linde, StatoilHydro, Shell, TOTAL, Vattenfall, Volkswagen, Hamburger Hochbahn

**Overall budget 2008 – 2011:** € 25.8 million

\_General modules: € 3.3 million    \_Cars: € 20.3 million    \_Hydrogen fuelling stations: € 2.2 million

\_Busses 2008 – 2010: (In a preparatory demonstration project, Daimler, Evobus and public transport company Hamburger Hochbahn are developing hybrid fuel cell busses)

The project will not become part of CEP until the preparatory demonstration is concluded): € 19.7 million

Information on funds allocated to a lighthouse is based on the overall budget agreed in 2008 specifying the period for which funds have been allocated. The NIP subsidy amounts to 48 percent in each case.



## DRIVING INTO THE FUTURE WITH HYDROGEN – THE CLEAN ENERGY PARTNERSHIP LIGHTHOUSE

The Clean Energy Partnership (CEP) came into being back in 2002 as an international joint venture of companies whose aim was to demonstrate the viability in everyday conditions of the energy source hydrogen as a fuel in vehicles and to test the infrastructure for refuelling the vehicles.

CEP entered its second phase in September 2008. Since then, CEP has received 48 percent of its total funding from NIP. CEP is made up of twelve partner companies: BMW Group, Berliner Verkehrsbetriebe BVG, Daimler, Ford, General Motors / Opel, Hamburger Hochbahn, Linde, Shell, StatoilHydro, TOTAL, Vattenfall Europe and Volkswagen.

Together with these companies, NOW plans to prove that normal users can now safely make use of hydrogen in road transport and that renewable energies can be viably used to provide the hydrogen.

CEP is concentrating initially on the key regions of Berlin and Hamburg in the biggest demonstration project of its kind in Europe. Some 30 cars are in daily use – and the number is due to be increased to over 40 very soon. Fleets of busses are also being used for public transport. And, of course, CEP also has a growing network of hydrogen fuelling stations.

All twelve partners and NOW work in close cooperation in the general modules. These general activities cover the fields of coordination and management, project representation, knowledge and information management, publicity and PR as well as work in committees. Vehicle manufacturers, mineral oil companies, energy providers and the gas industry are bundling their experience to enable CEP to speak with one voice.

Discussions on specific aspects are held in the working groups Cars, Busses, Infrastructure and Hydrogen Production.





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Around 30 hydrogen-powered cars are in daily use – and this number will be increased to over 40 very soon. The fleets are in operation in the key regions Berlin and Hamburg.



# Wasserstoff Hydrogen

As a lighthouse project with international impact the Clean Energy Partnership (CEP) is making a major contribution to establishing hydrogen as the »fuel of the future«. The project has been subsidized by the National Innovation Programme for Hydrogen and Fuel Technology (NIP) since 2008.



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Hydrogen is the most abundant element found in nature. An electrolyser can be used to break down water into its components hydrogen and oxygen.

## CARS AND HYBRID FUEL CELL BUSES IN EVERYDAY TEST CONDITIONS

Ten HydroGen4 from [General Motors/Opel](#) joined the CEP's fleet of cars in 2008. The HydroGen4 is a hydrogen fuel cell vehicle of the latest generation whose features include a 700 bar hydrogen storage system. The vehicles will be in daily use in Berlin until the end of the second CEP phase in 2010.

VW has increased the CEP fleet by the addition of its latest fuel cell vehicles, the HyMotion models based on the VW Tiguan. The vehicles are equipped with start-stop functionality and braking energy recovery and have made a major contribution to CEP's aim of establishing a fleet of 40 vehicles by 2010. [Volkswagen](#) plan to use the six vehicles to learn more about the supply, operation and performance of fuel cell vehicles.

[BMW](#) has been a pillar of strength since the early days of CEP. In Phase 2 the company will operate further BMW Hydrogen7 vehicles in Berlin. Unlike the vehicles of other manufacturers, most of the BMW Hydrogen7s are equipped with bi-valent H<sub>2</sub> combustion engines, although some of them have a monovalent H<sub>2</sub> combustion engine.

Demonstration operation, improvements in servicing and maintenance and in project management are [Daimler's](#) core aims for the use of its 10 A-Class hydrogen fuel cell vehicles. The cars are being subjected to testing in everyday situations in the hydrogen cities Hamburg and Berlin. During the second CEP phase, which expires in 2010, Daimler plans to increase

its fleet of small fuel cell cars in the customer section by the addition of Mercedes Benz B-Class fuel cell vehicles.

The hydrogen-powered busses integrated into the public transport systems of Berlin (BVG) and Hamburg (Hochbahn) commenced operation in the first CEP phase as part of the EU-subsidized project HyFleet:CUTE. The project »Sustainable Bus System of the Future« (NaBuZ) by partners [EvoBus](#), [Daimler](#) and [Hamburger Hochbahn](#) is at the demonstration preparation stage. The partners' aim is to use a small, initial series of ten fuel cell hybrid busses in Hamburg in Hochbahn's scheduled services. NaBuZ will become part of CEP as soon as this small series is operating as a demonstration project.

In future, wind will be the main renewable resource for hydrogen. The production of hydrogen from sustainable energy sources is one of the main tasks of CEP.



In future, wind will be the main renewable resource for hydrogen. The production of hydrogen from sustainable energy sources is one of the main tasks of CEP.

#### CLOSER NETWORK OF HYDROGEN REFUELLING STATIONS

**Shell Deutschland Oil GmbH** is planning an innovative hydrogen refuelling station. Compact, scalable pump technology for hydrogen refuelling is to be used on a large scale in Berlin and developed further in everyday operation. In this way, Shell aims to prove greater energy efficiency, a longer service life and less need for repairs.

**Linde** is closely involved in this project. The company plans to develop an innovative refuelling method for large-scale public refuelling based on a new concept which includes core components such as a 900 bar pump and a thermal block for the thermal treatment of the hydrogen. The aim of the new system is to save space and energy and ensure reliable series refuelling.

Linde is also continuing the operation of mobile 350 or 700 bar refuelling points in order to meet increasing demand from the expanding hydrogen fleet. Established in the first CEP phase, the refuelling system is located close to Berlin's city centre.

**TOTAL Deutschland** is creating a mobile 700 bar refuelling system for temporary use. In addition to supplying Berlin's fleet of hydrogen-powered vehicles, the company's aim is to thoroughly test mobile refuelling systems as a supply option for early markets.

TOTAL's service station in Heerstrasse, Berlin, continues to serve the CEP fleet in the second phase of the project. The refuelling station is designed for hydrogen vehicles with 350 and 700 bar storage systems. It also has the technical equipment necessary for refuelling with liquid hydrogen.

In the longer term, renewable energy sources, in particular, are to be used for hydrogen production. **Vattenfall** is an important member of CEP when it comes to establishing a hydrogen infrastructure of this nature in Germany.

GermanyHy, a study commissioned by NOW and the BMVBS, shows that we will in future obtain hydrogen from a mix of primary energy sources (natural gas, wind, biomass, etc.). The study also shows that CO<sub>2</sub> emissions in the transport sector can be very substantially reduced by the use of hydrogen. GermanyHy considers that the future cost (before tax) of hydrogen as a fuel will be acceptable, it will be in a similar range to the present cost of fossil fuels.

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Hydrogen and fuel cell busses serving regular routes have been a familiar sight on Hamburg's roads since 2003.





# future with hy



In Berlin, too, hydrogen busses – subsidized by the EU – are in use in scheduled services. The zero-emission vehicles have combustion engines which run on gaseous hydrogen.



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Filling up a hydrogen car is very little different from refuelling a conventional vehicle. Modern 700 bar refuelling stations refill a car in less than five minutes.

# Wasserstoff - H<sub>2</sub>



# Fuel Cell

driving the future

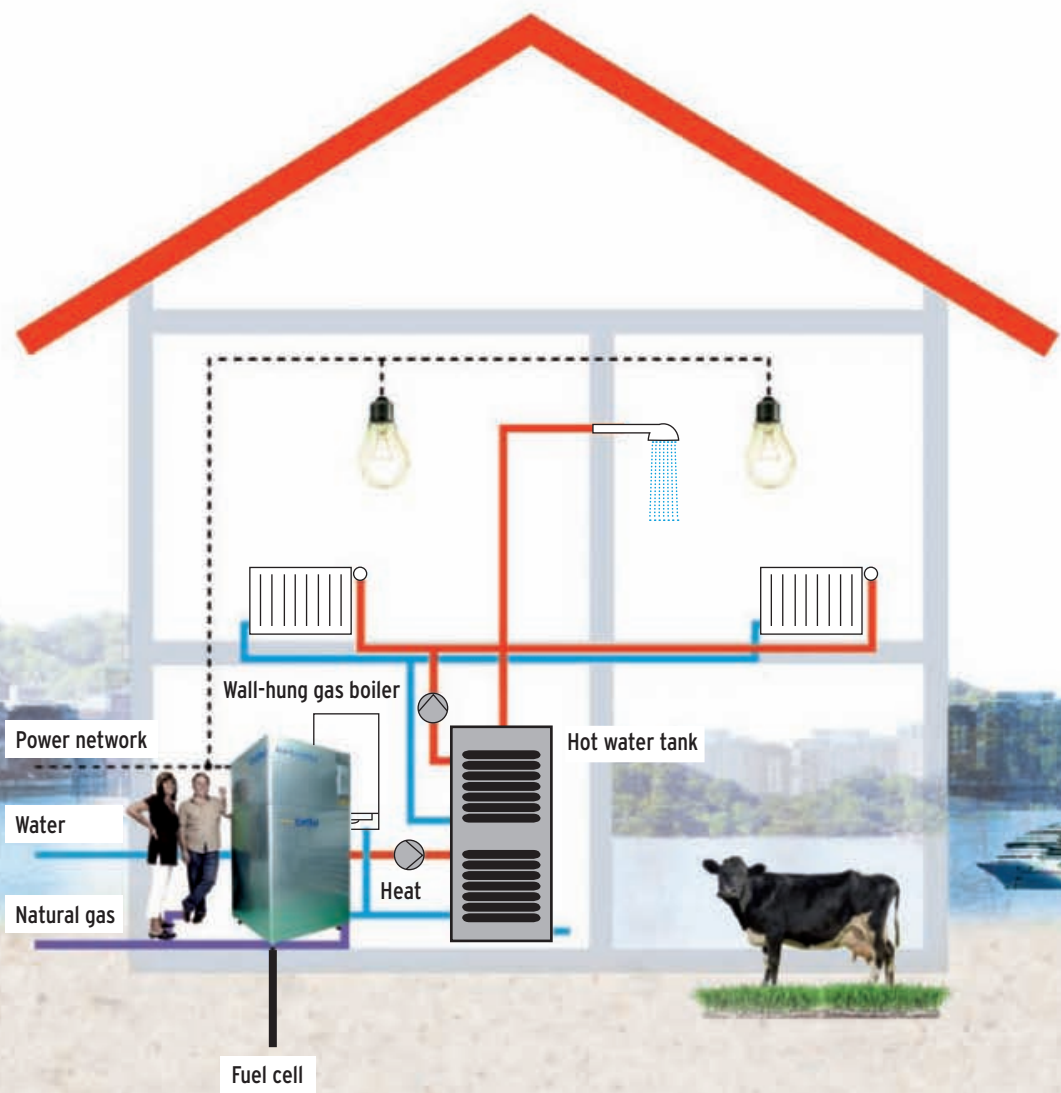
Car manufacturers are constantly improving zero-emission fuel cell drives. The findings gained from the demonstration projects are incorporated into ongoing research and development work.



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## HUGE POTENTIAL FOR SAVINGS WITH FUEL CELLS – PROGRAMME SECTOR STATIONARY APPLICATIONS





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Two-thirds of Germany's entire energy consumption is used for electricity, heating, hot water and increasingly also for air-conditioning. Energy savings through more efficient technologies can make a particularly effective contribution to climate protection here. A lot of energy, and thus CO<sub>2</sub>, can be saved by the use of fuel cells operating in combined heat and power systems.

Biogenic fuels such as biogas can also be used to provide energy with virtually no CO<sub>2</sub> emissions. NOW's programme sector Stationary applications covers domestic and industrial energy supplies as well as onboard power supply for large vessels.

In this sector, NOW initiates and coordinates extensive projects aimed at demonstrating the strengths of fuel cell technology in practice. In the long-term it is hoped to develop viable products for the world market. The projects subsidized support this development by discovering potential for improvements and establishing production and supply chains.



Press conference with Wolfgang Tiefensee, Federal Minister of Transport, to kick off the Callux lighthouse on September 23, 2008.



» In its programme sector Stationary applications, NOW initiates and coordinates extensive projects aimed at demonstrating the strengths of fuel cell technology – high efficiency, low emissions – in practice.«



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Production of a small series of prototypes used in the Callux field test. In Callux, hydrogen is obtained from natural gas and used for the highly-efficient domestic supply of heat and power.

## KEY FIGURES, CALLUX

**Partners:** EnBW, E.ON Ruhrgas, EWE, MVV Energie, BAXI INNOTECH, Hexis, Vaillant, ZSW

**Overall budget 2008 – 2011:** € 25.1 million

**\_Lighthouse field test Phase 1, 2008 – 2011:** € 12.8 million

**\_Accompanying module Phase 1, 2008 – 2011:** € 12.3 million



Information on funds allocated to a lighthouse is based on the overall budget agreed in 2008 specifying the period for which funds have been allocated. The NIP subsidy amounts to 48 percent in each case.

### »TESTED IN THE HOME« – CALLUX BRINGS HEAT AND LIGHT FROM FUEL CELLS

In the field of domestic energy the Callux lighthouse project (the name Callux is made up of the Latin words calor = heat and lux = light) is the mainstay of NIP. Over the entire period of the project (2008 to 2015) up to 800 fuel cell heating devices will be used in Callux for the supply of domestic heat and power.

Systems with PEM (polymer electrolyte membrane) and SOFC (solid oxide fuel cell) technology will both be tested. Phase 1 of the project has been running since September 2008. 48 percent of the cost of Callux is covered by funds from NIP, which makes NOW a powerful and committed partner to the project. The aim of Callux is to further develop existing technology towards reliable systems suitable for everyday use through the purchase, installation and operation of large numbers of fuel cell heating devices by the energy providers involved. This will help prepare for the market launch of fuel cell heaters powered by natural gas.

The core elements of the project are the field test modules of energy providers **EnBW**, **E.ON Ruhrgas**, **EWE** and **MVV Energie**. These companies purchase state-of-the-art fuel cell heating devices, make them available to interested private customers and test the use of the technology in everyday practice. The energy providers purchase the heating devices on the basis of long-term contracts with device manufacturers **Baxi Innotech**, **Hexis** and **Vaillant**. Thus initial small production runs with the appropriate supplier chains are established.

### IN THE GENERAL PROJECT MODULES, ALL PARTNERS WORK TOGETHER FOR FUTURE MARKET SUCCESS

Parallel to the field test projects, all partners to the project – energy providers, manufacturers and the **ZSW (Centre for solar energy and hydrogen research Baden-Württemberg)**, which is also involved – work in close cooperation in a general project module. Together, the partners deal with topics which must be tackled if market preparation for fuel cell heating devices is to be successful.

These include improvements to overall conditions such as the development of appropriate standards and regulations and the training of partners in the market. Technicians in the sanitary installation sector, in particular, must be prepared for the use of the new devices. The partners also cooperate closely in the fields of market research and communication and join forces in maintaining statistics on the systems installed.


Callux has also proved to be splendid example of corporate cooperation. This lighthouse has succeeded in bringing together the heating and energy sectors in a joint project – a procedure which is decisive to future market success, as only in this way can obstacles relating to capital resources, regulations and the sustained transfer of knowledge be overcome.



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One of the aims of Callux is to strengthen and expand the industrial base for stationary fuel cells in Germany. For this, supply chains must be created in the market preparation phase.



A close-up photograph showing a gloved hand holding a thin, rectangular, metallic-looking component, likely a fuel cell membrane or electrode. The component is being held over a stack of similar components, which are held together by a metal frame. The background is a blurred blue surface. The lighting is bright, highlighting the metallic texture of the components.

A fuel cell consists of electrodes separated from each other by a membrane or an electrolyte. In Callux, fuel cell systems are used to improve the energy supply to individual homes and apartment blocks through small combined heat and power systems.



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Fuel cell systems cover a wide range of performance, from small systems with two to five kilowatts to major plants with an output of several hundred kW.



#### KEY FIGURES, NEEDS

Partners: Dalkia Deutschland

Overall budget 2008 – 2011: € 3.8 million

#### KEY FIGURES, SPEICHERSTADT POTSDAM

Partners: SSP, CFC Solutions

Overall budget for preliminary project 2008: € 137,000

Information on funds allocated to a lighthouse is based on the overall budget agreed in 2008 specifying the period for which funds have been allocated. The NIP subsidy amounts to 48 percent in each case.

#### INDUSTRIAL ENERGY SUPPLY – NEEDS BOOSTS THE EFFICIENCY OF BIOGAS SYSTEMS

The NEEDS lighthouse was initiated in 2008 in the sector of industrial fuel cell systems for energy supply. Its aim is to develop standardized fuel cell systems in combination with biomass utilization plant (biogas, sewer gas, pyrolysis, synthesis).

Dalkia Deutschland is working on an initial system, made up of an MCFC fuel cell (molten carbonate fuel cell) and a gas motor block-type thermal power station with specially developed system management and control. The new system is designed for use in biogas plant. The MCFC is particularly well suited to permanent operation at the rated load point, while the gas motor block-type thermal power station converts the peak generation of biogas into heat and power, thus avoiding biogas burn-off. Additionally, the plant's waste heat is fed into a local heating system as useful heat. The installation of around 60 systems is planned as part of the NEEDS lighthouse by 2014.

#### HISTORIC BUILDING, ULTRA-MODERN ENERGY SUPPLY – POTSDAM'S SPEICHERSTADT

Another lighthouse project is underway in Potsdam's »Speicherstadt« warehouse area. The historic warehouse area is the main development site in the Potsdam inner city. Its energy supply is to be highly efficient and completely CO<sub>2</sub> neutral. The project will combine innovative construction methods to minimize consumption with a high-performance MCFC fuel cell block-type thermal power station and biogas generation from organic waste.

#### MTU ONSITE ENERGY AUTOMATES CELL PRODUCTION

MTU has initiated an individual project in the field of high-temperature fuel cells. The company is adapting and optimizing production processes in the course of the development of an automated production line – to date modules have been produced manually. The cell stacks produced in this way are being tested

in the lab and in practice. The project combines research with development and trials and is being financed jointly by the Ministry of Economics and Technology and the Ministry of Transport, Building and Urban Affairs. The total contribution from the latter ministry for the period 2008 to 2011 is € 5.6 million.



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This molten carbonate fuel cell of the latest generation has an output of 250 kW AC. It is in use in the combined heat and power system of MTU Friedrichshafen.







Commissioning of a new fuel cell block-type thermal power station at the test station. The cables are used to collect measurements.



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## MARKET ENTRY FOR FUEL CELLS – PROGRAMME SECTOR SPECIAL MARKETS







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Some fuel cell systems are already on the brink of market entry. These are usually products used in niche markets, which are referred to as special or early markets.

Uses for fuel cells range here from network-independent or critical power supplies in the IT and telecommunications sectors (computer centres, mobile/fixed line radio base stations) and logistics (fork-lift trucks) or portable applications (cell phones, cameras) to applications on the leisure and tourism market.

In demonstration projects in the NOW Special markets programme sector, industry is showing and testing the viability of these applications in everyday life as preparation for a market launch. Many of the Special markets product developments and prototypes are already well advanced and close to market readiness. The lighthouse principle plays its part here too – promoting wide-scale public awareness as well as development towards series production in the market preparation and entry phase. Thus the Special markets can have a useful function as passports to mass markets such as the automobile or domestic energy sectors.

A detailed technical line drawing of a mechanical assembly, possibly a turbine or engine component, is positioned on the left side of the page. The drawing shows various parts like a central shaft, blades, and housing, rendered in a clean, schematic style. It is partially obscured by the text and a green vertical bar on the far left.

**» Many of the Special markets  
product developments and proto-  
types are already well advanced  
and close to market readiness.  
Functioning, viable prototypes are  
already available for many  
applications.«**



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In the transport sector, fuel cells can be used for example to power traffic control systems.



## KEY FIGURES, BODENSEE

**Partners:** elcomax, SFC Smart Fuel Cell, Truma Gerätetechnik, Clean Mobile, EnyMotion, Dometic, Zentrum für BrennstoffzellenTechnik (ZBT)

**Overall budget 2008 – 2011:** € 24.2 million

Information on funds allocated to a lighthouse is based on the overall budget agreed in 2008 specifying the period for which funds have been allocated. The NIP subsidy amounts to 48 percent in each case.

### HOLIDAYS WITH FUEL CELLS – NEW SOLUTIONS FOR ONBOARD POWER SUPPLIES AND DRIVES FOR CAMPING AND LEISURE VEHICLES AND DRIVES FOR BOATS AND LIGHT VEHICLES

The leisure and tourism market holds many possibilities for fuel cell applications, and NOW is funding appropriate projects in this field. Initial individual projects in South Germany have been combined into the BODENSEE lighthouse. This enables cross-sectional topics to be processed efficiently and synergies created.

The BODENSEE project is testing the use of fuel cells for onboard power supplies for camping vehicles (camper vans, caravans) and drives for leisure vehicles (boats, light vehicles). In line with proven lighthouse principles, these tests take place under everyday conditions. A further aim is to attract the high level of public attention possible for fuel cell applications in this sector. The BODENSEE lighthouse has the support of the federal state of [Baden-Württemberg](#) as main partner for a period of one year.

#### THE INDIVIDUAL PROJECTS IN THE BODENSEE LIGHTHOUSE

In the STEP project, [elcomax](#), [SFC Smart Fuel Cell](#) and [Truma Gerätetechnik](#) are developing a new technology generation of membrane electrode assemblies (MEA), which make up the »heart« of the fuel cell. The next fuel cell generations for DMFC (high-temperature fuel cells) and HT-PEM (polymer electrolyte membrane fuel cells) are being produced using substantially cheaper MEAs.

In the project »DMFC drives for light electric vehicles«, project partners [Clean-Mobile](#) and [SFC Smart Fuel Cell](#) are developing a DMFC

system platform specially designed for the requirements of the LEV (light electric vehicles) market. The emphasis is on the optimization and efficiency of the entire power supply and drive system and the demonstration of the various types of LEV in everyday use.

Truma Gerätetechnik are further developing a reformer fuel cell system in the project »On-board power supplies for leisure vehicles«. The system is being subjected to a practical test under realistic conditions and is being used for network-independent onboard power supply (auxiliary power supply) for leisure vehicles. In a twin-stage field test, selected end consumers and vehicle manufacturers are initially testing the every-day use of 50 systems.

[EnyMotion](#) and the [Center for Fuel Cell Technology \(ZBT\)](#) are cooperating on the »Fuel Cell 4 Leisure« project in which existing 250 Watt fuel cell systems with camping gas as fuel are integrated into leisure applications (camper vans and boats). They are being tested in field tests and further developed to meet specific needs relating to reliability and suitability for everyday use.

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Low temperature fuel cells are usually chosen for mobile applications as they generate power at low temperatures.







The camping and leisure market offers numerous possibilities for the use of fuel cells. The BODEN-SEE lighthouse includes trials of onboard power supply systems for camper vans using fuel cells.



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Fuel cell technology has progressed beyond the nursery stage. Its many positive properties include long autonomy periods, scalable output and a high level of reliability and robustness.



Minimal maintenance and a high degree of environment friendliness are typical of fuel cell systems. It is often chosen, therefore, for remote locations.

### NEW TECHNOLOGY FOR POLICE AND FIRE BRIGADE RADIO – FUEL CELLS IN REMOTE LOCATIONS AND FOR CRITICAL POWER SUPPLY

Requirements of the high-security radio networks of police and fire brigades are high. In the case of catastrophes and other emergencies, base station power supply to the radio networks must be absolutely reliable and be guaranteed over long periods. Fuel cell technology now offers an ideal alternative to conventional solutions in the field of power supply systems for digital radio networks for public authorities and security-relevant organizations. They are particularly advantageous where stored energy times in excess of two hours are required.

Market requirements meant that NOW's activities in this segment focused initially on digital radio networks for security-relevant organizations. In order to develop a strategic approach to these promising areas, NOW organized the »security-relevant organizations networks« workshop at which the relevant manufacturers of fuel cell systems got together with the aim of identifying synergies and jointly overcoming barriers to market entry.

The following companies have initiated the first steps towards an appropriate lighthouse in the segment »critical power supply«:

[Air Liquide Deutschland](#), [b+w Electronic Systems](#), [Fuel Cell Technology Consulting](#), [FutureE Fuel Cell Solutions](#), [IdaTech Fuel Cells](#), [P21](#), [PASM Power and Air Condition Solution Management](#), [Rittal](#), [Startup Partners](#).

Computer centres, traffic control systems and the base stations of mobile radio networks are further areas for the use of fuel cell systems as backup systems or as a network-independent power supply.



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The Clean Energy Partnership (CEP) is one of the biggest field projects of its kind in the world. NOW's mission also includes promoting international relations in the area of hydrogen and fuel cell technology.



## WORKSHOPS

Commissioned by NOW, the Fuel Cell Education and Training Center Ulm on July 7, 2008 held the workshop »Renewable hydrogen from electrolysis« with the aim of determining the state of the art in electrolysis technologies and defining requirements profiles for future use in the compensation of fluctuating energies and the provision of hydrogen as a fuel. Requirements for future activities in research and development within NIP were derived from the results and the next steps to be taken were discussed.

On October 8, 2008, NOW, supported by Ludwig-Bölkow Systemtechnik GmbH, held the workshop »Hydrogen from wind energy« for an in-depth discussion of the compensation of fluctuating energies, in particular wind energy. Participants discussed overall concepts and operator models for the production, storage and reconversion of hydrogen and the integration of such systems into the energy and transport sector as a whole. In conclusion requirements for demonstration projects and studies were defined.

On November 27, 2008, NOW held the workshop »Training and qualification in the area of hydrogen and fuel cells in Germany«.

This meeting between representatives of industrial associations, chambers of industry, educational institutions and industry represented an initial step towards greater transparency in necessary training and qualification measures, also in relation to the National Innovation Programme (NIP). In addition to the training and qualification measures already existing within individual demonstration projects and light-houses, specific topics for further training are to be identified in the near future and appropriate programmes set up as necessary.



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Parliamentary evening, July 2008







With funding from:



following a resolution by the  
German Bundestag

## PHOTOS

### **PROGRAMME SECTOR TRANSPORT INCLUDING HYDROGEN INFRASTRUCTURE**

All photos from the Clean Energy Partnership (CEP). CEP is partner to the 12 companies BMW, Berliner Verkehrsbetriebe BVG, Daimler, Ford, General Motors / Opel, Hamburger Hochbahn, Linde, Shell, StatoilHydro, TOTAL, Vattenfall Europe and Volkswagen.

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$\text{H}_2\text{O} + \text{electricity} \cdot \text{H}_2 + \frac{1}{2}\text{O}_2$